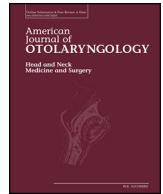




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## Safe tracheotomy for patients with COVID-19

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### ABSTRACT

Patients affected by severe acute respiratory syndrome coronavirus 2 disease (COVID-19) with respiratory distress may need invasive mechanical ventilation for a long period of time. Head and neck surgeons are becoming increasingly involved in the care of COVID-19 patients because of the rapidly increasing number of tracheotomies required. This procedure, when performed without protection, may lead to the infection of the medical and nursing staff caring for the patient.

The aim of this report is to share our protocol for performing a safe surgical tracheotomy in COVID-19 patients. Infection of the nursing/medical staff involved in the first 30 tracheotomies performed in patients affected by COVID-19 in the Intensive Care Unit of a tertiary referral center were evaluated. Mistakes that occurred during surgery were analyzed and discussed. None of the nursing/medical staff presented signs or symptoms of COVID-19 within 15 days after the procedure.

Conclusion: The authors have prepared a protocol for performing a safe surgical tracheotomy in patients affected by COVID-19. Surgeons who might be involved in performing the tracheotomies should become familiar with these guidelines.

### 1. Introduction

The emergence of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) disease (COVID-19) is a major public health emergency [1]. COVID-19 results in a clinical picture of atypical pneumonia, with 5% of patients admitted to the intensive care unit (ICU) [2]. Many of these patients may subsequently require tracheotomy. This procedure may lead to infection of the medical/nursing staff caring for the patient.

The aim of this report is to share our protocol for performing a safe surgical tracheotomy in COVID-19 patients. The possible mistakes that occurred during surgery and could lead to infection of the nursing/medical staff and are discussed here.

### 2. Case report

**Case 1.** A 56-year-old male with type II diabetes had fever and cough. His chest CT scan showed interstitial pneumonia. Molecular diagnosis based on nasal/oropharyngeal swabs confirmed SARS-CoV-2-related pneumonia. He was managed with lopinavir, ritonavir and hydroxychloroquine. Invasive ventilation with orotracheal intubation

was needed. His tracheal tube frequently became blocked with secretions and a surgical tracheotomy was required 5 days after.

**Case 2.** A 63-year-old woman with hypertension had fever and cough, followed by diarrhea and dyspnea. The chest CT scan and the oropharyngeal swab confirmed the diagnosis of SARS-CoV-2-related pneumonia. She was managed with lopinavir, ritonavir and hydroxychloroquine. She was admitted to the ICU for invasive mechanical ventilation. A surgical tracheotomy was required 12 days after.

Surgeons and anesthesiologists held a meeting to discuss the safest way to perform tracheotomy, which is herein reported.

#### 2.1. Surgical technique

The patient remained connected to the monitor and ventilator from the ICU. The surgical team consisted of two surgeons (at least one expert). All staff wore protective clothing: water-resistant disposable gown, cap, shoe covers, double gloves, N95 mask, goggles and face mask. The surgeon also wore sterile gown and gloves.

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Anesthesia consisted of midazolam, sufentanil and rocuronium. A shoulder support was positioned to obtain hyperextension of the neck.

Standard surgical tracheotomy was performed: a horizontal skin incision was made, the thyroid isthmus was transected if needed. The surgeon signaled that he or she was going to incise the trachea. Further doses of rocuronium were given just before incision of the trachea to reduce patient movement and cough. After pre-oxygenation with 100% oxygen for 3 min, apnea was allowed to reduce aerosol generation during incision of the trachea and insertion of a tracheostomy tube. The cuff of the oral endotracheal tube was deflated, and the tube was advanced distally 3 cm. The surgeon incised the trachea between rings II–III. Under direct view from the tracheotomy, the orotracheal tube was pulled back just above the tracheal incision but remained inside the larynx. The tracheal cannula was inserted. Ventilation was given again only after the cuff was inflated.

Once the tracheostomy tube was in place, as confirmed by the presence of carbon dioxide on end-tidal gas sampling, the oral endotracheal tube was completely removed from the patient and was disposed of in a plastic bag designated for contaminated waste.

Particular attention was paid to removing the staff's personal protective equipment to avoid self-contamination.

## 2.2. Mistakes

**Case 1.** After the insertion of the cannula, we noticed that the cuff was broken. We immediately stopped ventilation. No other tracheal cannula was present inside the ICU room. We asked the nurse standing outside the room to bring a cannula. The orotracheal tube had already been completely removed from the patient, who had desaturation to 50%. It took approximately 1 min to obtain another available tracheal cannula.

**Case 2.** The anesthesiologist was a young resident. After the surgeon signaled that he was going to incise the trachea, apnea was not correctly facilitated. Air flowed from the airway, generating aerosols.

## 3. Discussion

As communication abilities of the staff are hindered by the bulky personal protective equipment and by the isolated environment, problems should be anticipated according to an agreed upon plan. Key elements of the protocol for the surgical tracheotomy in COVID-19 patients are reported in Table 1.

Performing the tracheotomy inside the ICU reduces the unnecessary disconnection of catheters and tubing during transfer to and from the operating table and reduces the need for additional nursing staff, which is awfully lacking in this emergency epidemic context.

To minimize the operating time, the team consisted of at least one expert surgeon.

In Case 1, much time was wasted in transporting another tracheal cannula to the ICU room. At least two tracheal cannulas of different diameters must be present and immediately available inside the ICU room during the procedure. Moreover, the orotracheal tube must not be completely removed from the larynx until correct positioning of the cuffed tracheal cannula has been verified. This allows the anesthesiologist to rapidly maneuver the tube forward if needed. A nurse must be on standby in the adjacent room to allow for rapid take over in case of problems.

In Case 2, aerosols were generated by the incorrect generation of apnea, due to the inexperience of the young resident anesthesiologist. This fact underlines the need for the presence of an expert anesthesiologist during the procedure.

Electrocautery generates aerosols with blood and should be avoided.

A nurse specifically trained in infection control was required to supervise the removal of personal protective equipment. N95 masks were considered safe when performing tracheotomy in patients affected

**Table 1**

Key elements of the protocol for the surgical tracheotomy in COVID-19 patients.

Indications	Prolonged tracheal intubation Weaning facilitation Tracheal tube frequently blocked with secretions
Setting	ICU's room (preferably with negative pressure)
Staff	Two ENT surgeons (at least one expert surgeon) One expert anesthesiologist One scrub nurse One standby nursing staff member inside the ICU's room A nurse standing outside the ICU's room
Before surgery	Wear protective clothing <sup>a</sup> Keep all the necessary inside the ICU room (a tracheostomy set of instruments, at least two tracheal cannula, bipolar cautery, a shadowless lamp) Keep all the necessary inside the ICU room (a tracheostomy set of instruments, at least two tracheal cannula, bipolar cautery, a shadowless lamp)
Procedure: surgical tips	Paralyze the patient Establish adequate preoxygenation (100% for 3') Avoid electrocautery, limit the use of bipolar cautery Stop mechanical ventilation before tracheotomy Deflate the cuff of the tracheal tube Push the tube forward 3 cm Perform tracheotomy with cold knife No tracheal or wound suctioning of blood or secretions should be attempted if not needed, to avoid aerosol generation Pull the endotracheal tube just above the tracheal incision, under direct vision Don't remove the tube from the larynx Insert the tracheal cannula Control that the tracheal cannula is correctly inflated Give ventilation again only after the cannula is correctly inflated Suture the tracheal cannula to the skin Remove the endotracheal tube
After surgery	Careful removal of personal protective equipment with supervision Take a shower

<sup>a</sup> Shoe covers, cap, N95 (or N99 if available) mask, goggles, plastic full-face shield, goggles, water-proof disposable gown (complete gowning to cover the whole body should be preferred), double gloves. The surgeons must also wear sterile gown and gloves.

by severe acute respiratory syndrome (SARS) [3,4]. We note that the neck of the surgeons was not completely covered during the procedure. Complete gowning to cover the whole body of medical/nursing staff should be preferred, if available. However, an incapacity to rapidly respond to the widespread epidemic can cause an unavailability of adequate protective gear in hospitals. Therefore, immediately after the procedure, the surgeons thoroughly disinfected their necks with alcoholic gel and took a shower.

The ENT team of the hospital should be debriefed soon after the first surgeries to prepare all surgeons for the following procedures.

In our hospital thirty patients affected by COVID-19 underwent surgical tracheotomy. None of the medical and nursing staff presented signs/symptoms of COVID-19 within 20 days after the procedure.

Surgeons who might be involved in performing tracheotomy in COVID-19 patients should become familiar with this procedure.

## Ethic approval

This research has been conducted in accordance with ethical principles, including the World Medical Association Declaration of Helsinki (2002). The local ethical committee Area Vasta Emilia Nord does not perform a formal ethical assessment for case series.

## Declaration of competing interest

None.

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